4. Requirements (Normative)

4.1 Downlink Parameters

Table 1 below defines the relevant downlink OSI layer 1 parameters.
The parameters which have been marked with an asterisk (*) are subject to legal type approval requirements. These parameters are specified in ITU-R standard pr-ITU***XX. Equipment meeting the requirements of the ITU-R standard will simultaneously satisfy the corresponding requirements in this ISO standard.

Table 1 Downlink parameters

	Parameter	Values
D1(*)	Carrier Frequencies	- To be allocated in each country : 5.8 GHz band - Two downlink channels : 10 MHz apart from each other
D1a(*)	Alienate Frequencies of Transmitter from Receiver	40 MHz
D1b(*)	Allowable Deviation of Carrier Frequencies	±20 ppm
D2(*)	RSU Transmitter Spectrum Mask	(1) Occupied bandwidth: ≦ 8MHz (2) Adjacent channel power: ≦ -40 dB referred to carrier power (3) Spurious emissions ≦ 25 μ W
D3	OBU receiver bandwidth	5 MHz (typ.)
D4	Maximum E.I.R.P.	Class 1: Power supplied to antenna ≦ +10 dBm Antenna gain ≦ 12 dBi Therefore, the maximum E.I.R.P. ≦ +22 dBm Class 2: Power supplied to antenna ≦ +24.77 dBm(*) Antenna gain ≦ 20 dBi(*) Therefore, the maximum E.I.R.P. ≦ +44.77 dBm Both values not including variation of power supplied to the antenna.
D4a	Angular E.I.R.P. mask	Class 1 : Θ≦ 55° : ≦ +22dBm Θ> 55° : ≦ +7 dBm Class 2 : Not specified
D5	Antenna Polarization	Right hand circular

D6(*)	Modulation	ASK
D6a	Modulation index	0.75–1.0
D6b	Eye pattern	≧80% (time) / ≧80% (amplitude)
D7(*)	Data coding	Manchester code
D8(*)	Bit rate	1.024 Mbps
D8a(*)	Tolerance of bit clock	±100 ppm
D9	Bit error rate (B.E.R.)	10^{-5} for reference only
D10	Wake-up Process for OBU	Wake-up process on ordinary data
D10a	Maximum start time	≦ 5ms
D11	Power limits within communication zone	Class 1 : Minimum incident power : -54 dBm E.I.R.P. Maximum incident power : -41 dBm E.I.R.P. Class 2 : Minimum incident power : -56 dBm E.I.R.P. Maximum incident power : -40 dBm E.I.R.P.
D12	Burst Transmission Transient Response Time	Tbst By the expression on the right
D13	Allowable Deviation of Absolute Signal Transmission Time	Δ Tabs By the expression on the right
		2|Δ Tabs|+Tbst<15.625 μ S
D15(*)	Leakage Power in Standby mode	≦ 25 μ W
D16	Spurious Responses	Within 5.8 GHz ISM band; ≧ 24 dB Without 5.8 GHz ISM band; ≧ 18 dB Both values not including the image frequency response.

(*)-Downlink parameters subject to Certification.

4.2 Uplink parameters

Table 2 below defines the relevant uplink OSI layer 1 parameters.

The parameters which have been marked with an asterisk (*) are subject to legal approval requirements. These parameters are specified in ITU-R standard pr-ITU***XX. Equipment meetings that satisfy the requirements of the ITU-R standard also satisfy those of this ISO pre-standard.

Table 2 Uplink parameters

	Parameter	Values
U1(*)	Carrier frequencies	- To be allocated in each country : 5.8 GHz band - Two uplink channels : 10 MHz apart from each other
U1a(*)	Alienate Frequencies of Transmitter from Receiver	40 MHz
U1b(*)	Allowable Deviation of Carrier Frequencies	±100 ppm
U2(*)	OBU Transmitter Spectrum Mask	(1) Occupied bandwidth: ≦ 8MHz (2) Adjacent channel power: ≦ -40 dB referred to carrier power (3) Spurious emissions ≦ 25 μW
U3	RSU receiver bandwidth	5 MHz (typ.)
U4	Maximum E.I.R.P.	Power supplied to antenna ≦ +10 dBm(*) Antenna gain ≦ 10 dBi(*) Therefore, the maximum E.I.R.P. ≦ +20 dBm Variation of power supplied to the antenna not included.
U5	Antenna polarization	Right hand circular
U6(*)	Modulation	ASK
U6a	Modulation index	0.75-1.0
U6b	Eye pattern	≧80% (time) / ≧80% (amplitude)
U7(*)	Data coding	Manchester code
U8(*)	Bit rate	1.024 Mbps
U8a(*)	Tolerance of bit clock	±100 ppm

U9	Bit error rate (B.E.R.)	10^{-5} for reference only	
U11	Power limits within communication zone	Class 1: Minimum incident power: -58 dBm E.I.R.P. Maximum incident power: -46 dBm E.I.R.P. Class 2: Minimum incident power: -72 dBm E.I.R.P. Maximum incident power: -48 dBm E.I.R.P.	
U12	Burst Transmission Transient Response Characteristics	Tbst By the expression on the right	$2\|\Delta Tabs\|+Tbst<15.625\ \mu S$
U13	Allowable Deviation of Absolute Signal Transmission Time	Δ Tabs By the expression on the right	
U14	Transmission / Reception Turn Around Time	$\leqq 64\ \mu S$	
U15(*)	Leakage Power in Standby mode	$\leqq 2.5\ \mu W$	
U16	Spurious Responses	Class 1 : Within 5.8 GHz ISM band; $\geqq$ 23 dB Without 5.8 GHz ISM band; $\geqq$ 16 dB Class 2 : Within 5.8 GHz ISM band; $\geqq$ 30 dB Without 5.8 GHz ISM band; $\geqq$ 26 dB	
U17	Frequency Selecting Process	Not specified.	
U17a	Frequency selecting time	Within 9 frames	
U18(*)	Call Sign Transmission Process	Differs by the country and/or area.	

(*)-Uplink parameters subject to Certification.

5. Appendixes

Appendix A: Bibliography (Informative)

Table A1: Documents, served as references while preparing the standard

No.	Issuing organization	Title
1	ITU-R SG8 WP8A	*"Report of the Fifth Meeting of Working Party 8A (Attachment 9)" 2 Apr 1996*

Table A2: Documents, which can provide further insight into the evolution of the standard

No.	Issuing organization	Title
1	CEN TC278	"DSRC Physical Layer using Microwave at 5.8GHz", CEN DRAFT prENV278/9/#62, Oct. 1995
2	ETSI	"Technical characteristics and test methods for data transmission equipment operating in the 5.8GHz ISM band", ETSI FINAL DRAFT pr1-ETS 300 674. Sep 1996
3	ASTM, Technical Committee	*"Standard for Dedicated, Short Range, Two-Way Vehicle to Roadside Communications Equipment", ASTM Draft6, Feb 23 1996*
4	ASTM, Technical Committee	*"Dedicated Short-range Communication (DSRC) Physical Layer using Microwave in the 902 to 928 MHz band", ASTM Exxx-97, V.3.4 February 1997*
5	ITS America, ETTM User Group	"ETTM User Requirements of Toll Operating Authorities for Future National Interoperability" Final Version 3.1, June 12 1995
6	ISO TC204 WG15 Committee of Japan	*"DSRC. HDR Measurement Guideline" being prepared.*
7	ISO TC204 WG15 Committee of Japan	*"Further Detail of DSRC Physical Layer using Microwave at 5.8GHz. HDR" being prepared*

Appendix B: Installation and Re-use Distance of DSRC Equipment (Informative)

To enable interoperability between different DSRC equipment fulfilling the requirements of this Pre-Standard, it is believed to be necessary to consider also the installation requirements. Such installation requirements may distinguish between different TICS applications. Considering e.g. Automatic Fee Collection or Automatic Vehicle Identification, the OBU antenna could be installed in the center of the vehicle, possibly on the dashboard or behind the rear mirror. the direction of the OBU antenna should be matched to the intended configuration of the DSRC communication zone.

The installation geometries to some extent also influence the aspect of minimum re-use distance between independent, non-synchronized communication channels caused by interference. The re-use distance is also dependent on specific implementation parameters such as RSU antenna gain and RSU transmitter spectrum mask class. In the preparation of this pre-standard, re-use distances were calculated using a free-space propagation model, even though under specific instances shorter re-use distances may be attained.

To give an outline of predictive calculation using a free space model, asynchronous re-use distance is calculated on the basis of the following preconditions. Fig. B1 shows an interference model in the re-use distance calculation for reference.

(1) RSU transmission level Class 1: +16.0 dBm E.I.R.P.
Class 2: +27.8 dBm E.I.R.P.

(2) OBU transmission level: +12 dBm E.I.R.P

(3) Desired signal transmission distance
Class 1: 6 m (propagation loss: 63.3 dB)
Class 2: 30 m (propagation loss: 77.3 dB)

(4) RSU reception sensitivity: Class 1: -65 dBm
Class 2: -75 dBm

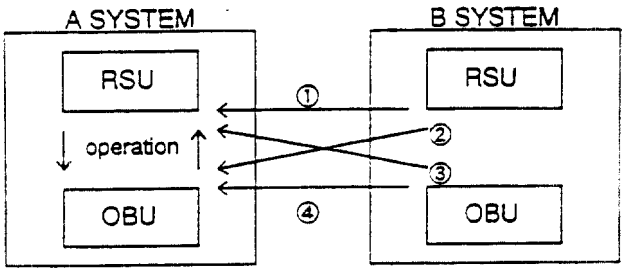
(5) OBU reception sensitivity: -60 dBm

(6) Desired signal receiving power fluctuation margin: 10dB
(windshield, wiper, installation angle and reflection)

(7) Undesired signal receiving power lowering (by windshield): 3dB

(8) RSU antenna side lobe suppression: Class 1: 20 dB
Class 2: 17 dB

(9) Required D/U ratio: 14 dB



Interference path ①: B System downlink on A System uplink
Interference path ②: B System downlink on A System downlink
Interference path ③: B System uplink on A System uplink
Interference path ④: B System uplink on A System downlink

Fig. B1 Interference Model for Re-use Distance Calculation

On the basis of these preconditions and the free space propagation theory, a re-use distance under a typical operational condition is calculated for the reference of RSU and otner equipment layout. The typical operational condition stated above refers to a condition where OBU is installed to a forward section inside a vehicle traveling on a flat road, where RSU is installed on the road side supported by a gantry, a single pole or otherwise. The antenna beam is directed downward to a prescribed communication area from the above. Therefore, directing the antenna to the reverse direction of other system further reduces the re-use distance introduced here. Conversely, directing it to the same direction of the other system may possibly increase the re-use distance. Moreover, with regard to detailed installation of the equipment, sufficient consideration will be required for the effect of reflection and/or diffraction caused by the surrounding installation environment and structures.

There are following two types of functional degradation of DSRC system that determines the re-use distance:

(1) Communication disturbance: A mode where communication is disturbed by interference from other transmitter stations during communication between RSU and OBU. Acquisition of required D/U is the determinant factor of re-

use distance under this mode.

(2) False communication: A mode where a receiving station mistakes interference from other station for a normal station of communication. Under this mode, whether the received power of interference exceeds the reception sensitivity of the receiver unit will be the determinant factor of re-use distance. In other words, false communication maybe generated if either ② or ③ in Table B1 exceeds the reception sensitivity, and a false communication occurs if both ② and ③ occur simultaneously.

Tables B1 and B2 indicate the result of calculation of re-use distance to the RSU transmitter spectrum mask on the basis of these preconditions and free space propagation theory.

Table B1: Result of Re-use Distance Calculation (Communication disturbance)

	Re-use distance (m)			
Interference path	①	②	③	④
Class 1 mutual	negligible	7	7	negligible
Class 1 to Class 2	negligible	9	48	negligible
Class 2 to Class 1	negligible	37	7	negligible
Class 2 mutual	negligible	48	48	negligible

Table B2: Result of Re-use Distance Calculation (False communication)

	Re-use distance (m)			
Interference path	①	②	③	④
Class 1 mutual	negligible	2.3	4.1	negligible
Class 1 to Class 2	negligible	2.3	4.1	negligible
Class 2 to Class 1	negligible	13	13	negligible
Class 2 mutual	negligible	13	13	negligible

Appendix C: Link budget related parameters(Informative)

In the preparation of this pre-standard, link budget related parameters were defined in a way to make them independent of application specific conditions. Examples of receiving level fluctuation values are shown in Table C1.

Table C1: Example of fluctuation parameters (one-way)

Windscreen loss	3dB
Loss by wiper	2dB
OBU installation angle	2dB
Loss by reflection	3dB
Total	10dB

Appendix D: Example of Link Design

Table D2 shows an example of link design as a reference in applying this pre-standard. Example parameters for the link design are shown in Table D1. The OBU is assumed to exist at 1 m above the road surface at the end of the communication zone. The RSU installation height is 5 m in the lane type and 6 m in the other type.

Table D1: Example of parameters (tentative values)

	RSU→OBU	OBU→RSU	Remarks
Radio transmission speed	2.048Mbaud (Manchester coding of 1.024 Mbps signal)		
Required bit error rate	10^{-5}		
Required C/N	20dB		
Occupied bandwidth	8MHz		
Antenna gain	12dBi (RSU)	2dBi (OBU)	
Receiver sensitivity	-60dBm (OBU)	-75dBm (RSU) or -65dBm (RSU)	

Table D2: Example of link design (tentative values)

	Lane based antenna		Approach antenna and Wide-area antenna		Navigation antenna	
	OBU→ RSU	RSU→ OBU	OBU→ RSU	RSU→ OBU	OBU→ RSU	RSU→ OBU
Transmission power (dBm)	-10	+10	-10	+24.8	+10	+15.8
Transmitting antenna gain (dBi) (*)	2	6	2	3	2	3
Propagation distance (m)	6		30		10	
Propagation loss (dB)	63.3		77.3		67.7	
Receiving antenna gain (dBi) (*)	6	2	3	2	3	2
Receiving power (dBm)	-45.3	-45.3	-62.3	-47.5	-52.7	-46.9
Required margin (dB)	10	10	10	10	10	10
Minimum receiving power (dBm)	-55.3	-55.3	-72.3	-57.5	-62.7	-56.9
Receiver sensitivity (dBm)	-65	-60	-75	-60	-65	-60
margin (dB)	9.7	4.7	2.7	2.5	2.3	3.1

(*)-Antenna gain includes the angle loss.

Appendix E: Frequency Selecting Process (Informative)

This pre-standard assumes two pairs of channels in the channel plan. Each pair consists of the up-link and down-link frequencies which are apart from each other by the alienated frequencies of transmitter and receiver. A conforming control example of the RSU and OBU is shown below.

E1 Frequency Selection Process

E1.1 Definition of Term

As described in the definition of parameter U17, the frequency selection process refers to the process for the OBU to receive the signal from the RSU in communication zone and select the frequency to be used in the OBU.

E1.2 Recommended Procedure

(1) RSU: Preset

(2) OBU: Receives the FCM and performs CRC when the receive signal level from the RSU exceeds the receiver sensitivity.
If the CRC result is OK, the frequency is set according to the operating frequency specification code in the FCM.

E1.3 OBU Operation

(1) The OBU should preferably compare the receiving power for each receiving frequency for judgement. The frequency should also be finalized after repeating CRC multiple times. This is because a process in which the receiving frequency is set according to the operating frequency specification code in the FCM after CRC of the FCM results in OK and the ACTC is sent for the FCM in the next frame attains CRC for two times.

(2) Examples of Frequency Selecting Process in OBU

a. Two receiving frequencies method (selection of two frequencies for FCM reception and 1 frequency after receiving the FCM)

b. Wide-band IF method

c. High-speed switcing method (high-speed frequency switching of local oscillator, etc.)

d. Method for obtaining the frequency information of the RSU to be passed next (Ex. From first to second antenna on lane base, allowing non-execution of frequency selecting process by OBU at second antenna)

e. Others

(3) Method for setting practical time window at OBU

In the case of the high-speed switching method, it is impossible for the OBU to know beforehand at what intervals the RSU sends the FCM. In such a situation, it will be the most practical to provide a fixed time window for the frequency selection process.

E2 Frame Length and Frequency Selection Time

In layer 2, the numbers of MDCs (message data channels) are actually set to 2, 4 and 8 as a series. Let's call these as frame classes A, B and C. Table E1 shows the absolute value of the frequency selecting time for each class.

Table E1 Frame Class and Frequency Selecting Time

Frame class	Frame length (number of slots)	Frame cycle (ms)	Frequency selecting time (ms)	Application example
A	1FCM+2MDC =3 slots	0.78125mS*3= 2.34375	21.09375	Lane based
B	1FCM+4MDC =5 slots	0.78125mS*5= 3.90625	35.15625	Approach and wide-area
C	1FCM+8MDC =9 slots	0.78125mS*9= 7.03125	63.28125	Approach and wide-area

Note: 1 slot = 100 octets. This corresponds to 0.78125 ms at 1.024 Mbps.

Table F1 List of Modifications

Page	Item	Version 0.3	Version 1.0	Remarks
1	Preparing organization	ISO TC208 WG15 SG. **	ISO TC204 WG15 SG. L1	
1	Members	WG15 Japan Committee members	WG15 SG. L1 project members	
4	D2a	Bandwidth in which 99% of the whole radiated power is contained.	The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5% of the total mean power of a given emission	
4	D3	6 dB bandwidth of the OBU receiver	3 dB bandwidth of the OBU receiver	
4	D5	Clockwise (or counterclockwise) rotation with time lapse	Clockwise (or counterclockwise rotation with time lapse as seen from the rear side of antenna	
5	D6a		Modulation index = (Vmax - Vmin) / (Vmax + Vmin), with the crest of amplitude waveform after detection by diode as Vmax and bottom of amplitude waveform after detection by diode as Vmin	Added sentence
5	D6b		Eye pattern (amplitude) = 2B/(A + B), with max. amplitude as A and min. amplitude as B. Eye pattern (time) = 2B'/(A' + B'), with max. zero-cross time width as A' and min. zero-cross time width as B'	Added sentence
6	D12		Burst transmission transient response characteristics: Rise time of signal from RSU	Item addition
6	D13		Leakage power in standby mode: Leakage power from RSU in standby mode	Item addition
6	D15		Leakage power: Power leaked from the RSU which is in the standby state	Item addition
6	D16		Spurious response: Interference ratio when B.E.R. of RSU is prescribed value.	Item addition
6	U3	6 dB bandwidth of RSU receiver	3 dB bandwidth of RSU receiver	Item addition

7	U12		Burst transmission transient response characteristics:	Item addition
7	U13		Allowable deviation of absolute signal transmission time	Item addition
7	U14		Transmission/reception turn around time: The time necessary at the OBU to switch from transmit mode to receive mode, or from receive mode to transmit mode.	Item addition
7	U15		Leakage power in standby mode	Item addition
7	U16		Spurious response	Item addition
7	U17		Frequency selecting process: Process for the OBU to receive the signal from the RSU in communication zone and select the frequency to be used in the OBU.	Item addition
9	D2(*)	≧ 60 dB with reference to carrier power	≦ [-60] dB with reference to carrier power	
9	D4(*)	Class 2: ≦ +46dBm	Class 2:≦ [+46] dBm	
9	D6a(*)	≧80%(time) / ≧85%(amplitude)	≧80%(time) / ≧80%(amplitude)	
10	D1*	Class 1: Minimum incident power: -53 dBm E.I.R.P. Maximum incident power: -40 dBm E.I.R.P. Class 2: Minimum incident power: -63 dBm E.I.R.P. Maximum incident power: -45 dBm E.I.R.P.	Class 1: Minimum incident power: [-53] dBm E.I.R.P Maximum incident power [-40] dBm E.I.R.P Class 2: Minimum incident power [-63] dBm E.I.R.P. Maximum incident power [-45] dBm E.I.R.P.	
10	D12		Burst transmission transient response characteristic: Planned to be specified.	Item addition
10	D12		Deviation of absolute signal transmission time: Planned to be specified.	Item addition
10	D15(*)		Leakage power in standby mode: Planned to be specified.	Added item
10	D16		Spurious response: Planned to be specified.	Added item
10	Outside the frame		Temporary value in [	Added

11	U2(*)	≧ 40 dB referred to carrier power	≦ [-40] dB with reference to carrier power	
11	U6a	≧80%(time) / ≧85%(amplitude)	≧80%(time) / ≧80%(amplitude)	
11	U9	Class 1: Minimum incident power: -59 dBm E.I.R.P. Maximum incident power: -46 dBm E.I.R.P. Class 2: Minimum incident power: -73 dBm E.I.R.P. Maximum incident power: -55 dBm E.I.R.P	Class 1: Minimum incident power: [-59] dBm E.I.R.P. Maximum incident power: [-46] dBm E.I.R.P. Class 2: Minimum incident power: [-73] dBm E.I.R.P. Maximum incident power: [-55] dBm E.I.R.P.	

Table F2 List of Modifications

*: Modified point in V2.0 from V1.1

Page	Item	Version 1.0	Version 2.0	Remarks
1	Project	WG15/PT**	WG15/PT-L1	
1	Members		Toyota Motor Corporation, Nissan Motor Co., Ltd., and Denso Co., Ltd.	Added.
1	Members	Vehicle Information and Communication System Center		Deleted.
4	D4	Maximum peak envelope power transmitted from RSU through isotropic antenna	Power supplied to an antenna multiplied by the absolute antenna gain in a given direction is called Equivalent Isotropic Radiation Power (E.I.R.P.) and an E.I.R.P. of the antenna directed to a maximum radiated power ia called Maximum E.I.R.P.	
6	D12	Rise time of signal from RSU	The response time from the power at the time of carrier off to the end of transient response or from the start of transient response to the power at the time of carrier off when the burst wave modulated by the digital signal from the RSU is turned on or off	
6	D13	Tolerance of absolute signal sending time: Maximum deviation of signal transmission time in RSU from the reference time.	Deviation of absolute signal transmission time: Deviation of the time from the start of control signal (FCM) transmission from the RSU to the end of receiving the final slot from the reference time.	
6	D16	Interference radio level when B.E.R. of the OBU is below prescribed value	Difference between the levels of operational radio +3 dB and the interference radio when B.E.R. of the OBU is below the prescribed value	
6	U2a	(Occupancy Frequency Bandwidth)	(Occupied Babdeidth)	Description by ITU

7	U4	Maximum peak envelope power transmitted from the RSU through the isotropic antenna	Power supplied to an antenna multiplied by the absolute antenna gain in a given direction is called Equivalent Isotropic Radiation Power (E.I.R.P.) and an E.I.R.P. of the antenna directed to a maximum radiated power is called the Maximum E.I.R.P.	
7	U13	Tolerance of absolute signal transmission time: Refer to D13.	Deviation of absolute signal transmission time: Deviation of the time between end of receiving the control signal (FCM) from the RSU and the start of OBU connection response from the reference time.	*
7	U17	Refer to D17.	Process for the OBU to receive the signal from the RSU in communication zone and select the frequency to be used in the OBU. Definite methods available are the two receiving frequency method, wide-band IF method, high-speed switching method and the method for obtaining the frequency selecting information from the information most recently received from the RSU.	* Process explanation
7	U17a		Frequency selecting time: Time required for frequency selection by the OBU. This period also includes the time for OBU wake-up or antenna selection if any.	* Added item
7	U18		Call sign transmission process: Transmission process of a code given as the identification signal of a radio station to identify that the OBU is a DSRC station.	Added

8	Units		dBi, ppm	Added
8	CEN	(European Committee for Standardization)	(Committee European de Normalization)	
8	E.I.R.P.	Equivalent Isotropic Radiation Power	Equivalent Isotropic Radiation Power	
9	D1a(*)	50 MHz	40 MHz	*
9	D4	Class 1: ≦ +22dBm Class 2: ≦ [+46]dBm	Class 1: Output supplied to antenna ≦ +10 dBm (*) Antenna gain ≦ [+10] dBi Therefore, the maximum E.I.R.P. ≦ [+22] dBm Class 2: Output supplied to antenna ≦ +25 dBm (*) Antenna gain ≦ [+20] dBi Therefore, the maximum E.I.R.P. ≦ [+45] dBm No deviation of the power supplied to antenna is included in either case.	
9	D5	D5(*)	D5	
10	D12	Planned to be specified.	≦ [3] μS	*
10	D13	Planned to be specified.	≦ [±4] μS	*
10	D15(*)	Planned to be specified.	≦ [25] μW	
10	D16		Within 5.8 GHz ISM band≧[24] dB Outside of 5.8 GHz ISM band≧ [18] dB	*
11	U1a(*)	50 MHz	40 MHz	*
11	U4	≦ +20 dBm	Output supplied to antenna ≦ +10 dBm (*) Antenna gain ≦ +10 dBi Therefore, the maximum E.I.R.P ≦ +20 dBm No deviation of the power supplied to antenna is included.	
11	U5	Clockwise circular polarization	Counterclockwise circular polarization	*
12	U12	Planned to be specified.	≦ [3] μS	*
12	U13	Planned to be specified.	≦ [±4] μS	*
12	U14	Planned to be specified.	≦ [35] μS	*
12	U15(*)	Planned to be specified.	≦ [2.5] μW	

12	U16	Planned to be specified.	Class 1: Within 5.8 GHz ISM band ≧ [23] dB Outside of 5.8 GHz ISM band ≧ [16] dB Class 2: Within 5.8 GHz ISM band ≧ [30] dB Outside of 5.8 GHz ISM band ≧ [26] dB	*
12	U17	Planned to be specified.	Not specified.	*
12	U17a		Frequency selecting time: Within [8] frames	Added item *
12	U18		Call sign transmission process: Varies with the country and/or area.	Added item
13	Table A2 No.4	*ASTM Exxx-97, November 1996*	*ASTM Exxx-97, V.2.0 December 1996*	V 2.0
14～15	Re-use distance		Full revision	Full revision *
17	Example of link design		Partial revision	*

Table F3 List of Modifications

Page	Item	Version 2.0	Version 3.0	Remarks
1	TR list	(*):Being prepared.	(*):Separate document	
2	ITU-R	ITU-R xx	ITU-R SG8 WP8A	
3	ISM band	**MHz	60MHz	
5	D1b	Tolerance of carrier frequencies	Allowable Deviation of carrier frequencies	Changed expression
5	D1b	1 pm	1 ppm	Error correction
5	D4	Class 1: For a transmission distance of 6 m or less	Class 1: For a transmission distance of 10 m or less	Changed boundary
5	D1b	Tolerance of carrier frequencies	Allowable Deviation of carrier frequencies	Changed expression
11	D1b(*)	Tolerance of carrier frequencies	Allowable Deviation of carrier frequencies	Changed expression
11	D2(*)	(2) Adjacent channel power: ≦ [-60] dB referred to carrier power	(2) Adjacent channel power: ≦ -40 dB with reference to channel power	
11	D4	Class 2: Power supplied to antenna ≦ +25 dBm (*) Antenna gain ≦ [20] dBi Therefore, the maximum E.I.R.P. ≦ [+45] dBm	Class 2: Power supplied to antenna ≦ +24.77 dBm (*) Antenna gain ≦ 20 dBi Therefore, the maximum E.I.R.P. ≦ +44.77 dBm	Changed range
11	D4a	Class 1: Θ≦55°: ≦+30 dBm Θ>55°: ≦+ 7 dBm	Class 1: Θ≦55°: ≦+22 dBm Θ>55°: ≦+ 7 dBm	
12	D12	≦ [3] μS	≦ [6] μS	L2 change
12	D13	≦ [4] μS	≦ [±8] μS	L2 change
12	D16		Both values do not include the image frequency response.	Added.
13	U1b(*)	Tolerance of carrier frequencies	Deviation of carrier frequencies	
13	U5(*)	Counterclockwise circular polarization	Right hand ciraular	
14	U12	≦ [3] μS	≦ [6] μS	L2 change
14	U13	≦ [4] μS	≦ [±8] μS	L2 change
14	U16		Both values do not include the image frequency response.	Added.
14	U17a	Within [8] frames	Within [9] frames	
15	Table A1	ITU-R	ITU-R SG8 WP8A	

15	Table A2	No.4 ASTM Exxx-97.V.2.0 December 1996	No.4 ASTM Exxx-97.V.3.4 February 1997	New draft
15	Table A2	No.6 ISO TC204 WG15 Committee of Japan	"DSRC. HDR Measurement Guidline" being prepared.	Added item
15	Table A2	No.7 ISO TC204 WG15 Committee of Japan	"Further Detail of DSRC Physical Layer using Microwave at 5.8 GHz. HDR" being prepared.	Added item
16	(1) RSU transmission level	Class 2 : +28 dBm E.I.R.P	Class 2: +27.8 dBm E.I.R.P.	Changed range
16	(2) Desired signal transmission distance	Class 1: 6m (propagation loss: 63 dB) Class 2: 30m (propagation loss: 77 dB)	Class 1: 6m (propagation loss: 63.3dB)) Class 2: 30m (propagation loss: 77.3 dB)	Changed range
20	Table D1	Radio transmission speed: 2Mbps	Radio transmission speed: 2Mbaud	Changed unit
20	Table D2		[Indication of detailed figures]	Figures changed to match the change in unit of propagation loss
21～22	Appendix E		Frequency Selecting Process	Wholly added

Table F4 List of Modifications

Page	Item	Version 3.0	Version 4.0	Remarks
1	Foreword line1	SG.xx	SG.L1	establishment
1	Foreword line14	CEN pr ENV 278/9/#	CEN ENV 278/9/#	vote at CEN
1	Foreword line21 Members		Hanshin Expressway Public Corporation	Added
7	D12	Burst Transmission Transient Response Characteristics	Burst Transmission Transient Response Time	
8	U1a	Alienate Frequencies of Transmitter from Receiver 50MHz	Alienate Frequencies of Transmitter from Receiver 40MHz	
9	U12	Burst Transmission Transient Response Characteristics	Burst Transmission Transient Response Time	
11	D4	Class 1: Power supplied to antenna ≦ +10 dBm(*) Class 2: Antenna gain ≦ 20 dBi	Class 1: Power supplied to antenna ≦ +10 dBm Class 2: Antenna gain ≦ 20 dBi(*)	(*) Deleted (*) Added
12	D5(*)	D5(*)	D5	(*) Deleted
12	D6a(*)	D6a(*)	D6a	(*) Deleted
12	D8(*)	1 Mbps	1.024 Mbps	Changed bit rate
12	D8a	D8a	D8a(*)	(*)Added
12	D11	Power limits within communication zone Class 1 : Minimum incident power : [-53]dBm E.I.R.P. Maximum incident power : [-40]dBm E.I.R.P. Class 2 : Minimum incident power : [-63]dBm E.I.R.P. Maximum incident power : [-45]dBm E.I.R.P.	Power limits within communication zone Class 1 : Minimum incident power : -54 dBm E.I.R.P. Maximum incident power : -41 dBm E.I.R.P. Class 2 : Minimum incident power : -56 dBm E.I.R.P. Maximum incident power : -40 dBm E.I.R.P.	Changed value [ ] Deleted
12	D12	Burst Transmission Transient Response Characteristics ≦ [6] μ S	Burst Transmission Transient Response Time Tbst By the expression on the right	Correlative expression

12	D13	Allowable Deviation of Absolute Signal Transmission Time ≦ [±8] μS	Allowable Deviation of Absolute Signal Transmission Time Δ Tabs By the expression on the right. (the expression on the right) 2|Δ Tabs |+Tbst<15.625 μS	Correlative expression
12	D15(*)	Leakage Power in Standby mode ≦ [25] μW	Leakage Power in Standby mode ≦ 25 μW	[ ] Deleted
12	D16	Spurious Responses Within 5.8 GHz ISM band; ≧ [24] dB Without 5.8 GHz ISM band; ≧ [18] dB	Spurious Responses Within 5.8 GHz ISM band; ≧ 24 dB Without 5.8 GHz ISM band; ≧ 18 dB	[ ] Deleted
12	Outside the frame	[ ] denotes a tentative value		Released a tentative value
13	U4	Maximum E.I.R.P. Antenna gain ≦ 10 dBi	Maximum E.I.R.P Antenna gain ≦ 10 dBi(*)	(*) Added
13	U5(*)	U5(*)	U5	(*) Deleted
13	U6a(*)	U6a(*)	U6a	(*) Deleted
13	U8(*)	1 Mbps	1.024 Mbps	Changed bit rate
13	U8a	U8a	U8a(*)	(*)Added
14	U11	Power limits within communication zone Class 1 : Minimum incident power : [-59]dBm E.I.R.P. Maximum incident power : [-46]dBm E.I.R.P. Class 2 : Minimum incident power : [-73]dBm E.I.R.P. Maximum incident power : [-55]dBm E.I.R.P.	Power limits within communication zone Class 1 : Minimum incident power : -58 dBm E.I.R.P. Maximum incident power : -46 dBm E.I.R.P. Class 2 : Minimum incident power : -72 dBm E.I.R.P. Maximum incident power : -48 dBm E.I.R.P.	Changed value [ ] Deleted
14	U12	Burst Transmission Transient Response Characteristics ≦ [6] μS	Burst Transmission Transient Response Time Tbst By the expression on the right	Correlative expression
14	U13	Allowable Deviation of Absolute Signal Transmission Time ≦ [±8] μS	Allowable Deviation of Absolute Signal Transmission Time Δ Tabs By the expression on the right. (the expression on the right) 2|Δ Tabs |+Tbst<15.625 μS	Correlative expression

14	U14	Transmission/Reception Turn Around Time≦ [35] μ W	Transmission/Reception Turn Around Time≦ 64 μ W	Changed value [ ] Deleted
14	U15(*)	Leakage Power in Standby mode ≦ [2.5] μ W	Leakage Power in Standby mode ≦ 2.5 μ W	[ ] Deleted
14	U16	Spurious Responses Class 1: Within 5.8 GHz ISM band; ≧ [23] dB Without 5.8 GHz ISM band; ≧ [16] dB Class 2: Within 5.8 GHz ISM band; ≧ [30] dB Without 5.8 GHz ISM band; ≧ [26] dB Both values not including the image frequency response.	Spurious Responses Class 1: Within 5.8 GHz ISM band: ≧ 23 dB Without 5.8 GHz ISM band; ≧ 16 dB Class 2: Within 5.8 GHz ISM band; ≧ 30 dB Without 5.8 GHz ISM band; ≧ 26 dB	[ ] Deleted Deleted the provision
14	U17a	Frequency selecting Within [9] frames	Frequency selecting Within 9 frames	[ ] Deleted
14	Outside the frame	[ ] denotes a tentative value		Released a tentative value
20	Table D1	Radio transmission speed 2M baud (Manchester coding of 1 Mbps signal)	Radio transmission speed 2.048 Mbaud (Manchester coding of 1.024 Mbps signal)	Changed bit rate
20	Table D2		A few values in the table changed	Changed the transmission power and the receiver sensitivity at the navigation antenna
22	Table E1		A few values in the table changed	Changed bit rate

APPENDIX D:
Data Link Layer